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PROPORTIONING OF LIQUID GLASS BATCH COMPONENTS

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The authors consider volumetric and weighing proportioners for liquid components of glass batch, as well as proportioners measuring the flow rate of liquids using vane flowmeters.

Liquid components of glass batch include water glass and caustic alkali solutions, water-potash mixture, water, fuel oil, furnace fuel, aqueous solutions of surfactants, and other additives.

Proportioning of liquid glass batch components is performed using different types of weighing and volumetric proportioners, as well as systems based on measuring the flow rate of fluids using electromechanical and ultrasonic flowmeters.

The simplest volumetric water proportioner that is used at some glass factories is a measuring tank equipped with manual or electromagnetic valves for feeding and discharging water and upper and lower level gages controlling the filling of the tank.

To ensure the required minimum pressure in water pouring by gravity from the measuring tank to the spraying injectors of the mixer for batch moistening, the measuring container has to be installed 8 – 10 m above the mixer level, which cannot always be achieved in the low-ceiling batch-preparation shops built in the middle of the past century.

The required pressure of water in the injectors can be developed by feeding compressed air through an electromagnetic valve into the measuring tank and thus effectively displacing water in the course of its discharge. In this case an additional electromagnetic valve is installed in the measuring tank, which opens and shuts, respectively, the opening for letting out air during the fill and discharge of water from the tank.

Considering that the use of compressed air transforms the measuring tank into a vessel operating under pressure, this design of the volumetric water proportioner has not found wide application.

A more widely used scheme involves moistening batch using a centrifugal pump automatically feeding water to the mixer from an intermediate accumulating tank equipped with water heating.

The duration of the pump operation is selected experimentally and depends on the pump capacity and the prescribed moisture of the batch. For instance, in order to ensure 4 – 5% moisture to a batch of 1.5 tons of raw materials in the mixer with a pump capacity equal to 2 liters/sec, the pump in each dosing cycle is switched on for 30 – 40 sec. As proportioning is based on time and the pump capacity during the day varies depending on voltage fluctuations in the power network, the water dosing precision with a centrifugal pump is no more than 1.0 – 1.5%.

Similar proportioning schemes for fuel oil using a gear-type pump do not have a high accuracy as well and are being replaced by more advanced dosing systems.

Contemporary domestic and foreign liquid-proportioning systems mainly use vane flowmeters generating electric pulses, whose number is proportional to the volume of the liquid passing through the meter.

A similar liquid proportioning complex, namely, KDZhR-25-2N produced by the Stromizmeritel' JSC (Fig. 1), contains system of pipeline *1*, vane flowmeter *2* with filter *3*, bypass line *4* with relay flow gage *5*, electric water heater *6* with bypass line *7*, ball valves *8* and *9* with pneumatic drives *10* and *11*, and spraying injectors *12 – 15*.

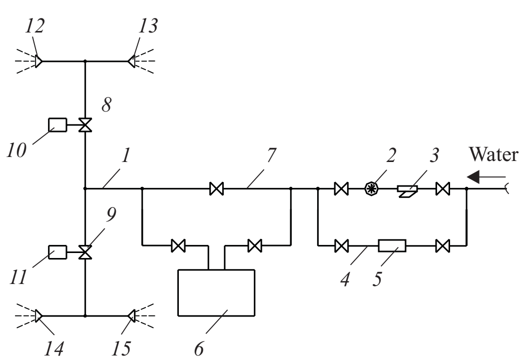

Fig. 1. Liquid proportioning complex KDZhR-25-2N.

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This complex in combination with the automated control system for batch preparation or an autonomous electric block provides controlled feed of water alternately to two mixers and heating cold water to 45 – 85°C.

The absolute dosing error is 0.01 – 1 liters and depends on the specific number of pulses generated by the flowmeter. The number of pulses is varied from 1 to 100 per liter of measured water and is set depending on the required dosing accuracy.

In the case of failure of the flowmeter or during maintenance, water can be supplied to the injectors via the bypass line. The presence of water is controlled by a relay flow gage and proportioning is performed based on time. Since pressure in the water supply system may vary and, therefore, significantly influence the proportioning precision, it is recommend to use the bypass line only in emergency and during repair works.

In the case of maintenance or when hot sand arrives at the supply hoppers of weighing proportioners from the thermal treatment and drying line and is loaded into the mixer, the electric heater can be switched off and cold water can be supplied to the injectors through the bypass line.

Technical parameters of liquid dosing complex KDZhR-25-2N with a flowmeter

Nominal hydraulic pass, mm	25
Transmitting capacity, liters/sec	0.4 – 1.2
Dosing discreteness, pulses/liter	1 – 100
Dosing error, liters	0.01 – 1
Water heating temperature, °C	45 – 85
Electric voltage, V:	
control circuits	220 ± 22
power circuits	380 ± 38
Network frequency, Hz	50 ± 1
Pneumatic supply network pressure, MPa	0.5 ± 0.1
Compressed air flow rate, m^3/min	Not more than 0.25
Water pressure in network, MPa	0.2 – 0.6
Power consumption, kW	24 ± 1.8
Ambient temperature, °C	5 – 40
Weight, kg	Not more than 92

The Stromizmeritel' JSC produces various modification of batch-moistening systems of different output, with or without a water heater, different numbers of injectors and executives mechanisms, different measuring instruments, and other parameters.

The fuel oil dosing device based on vane flowmeters operates similarly to water dosing systems and differ from them by the heat insulation in pipes to maintain the required viscosity of fuel oil and the presence of additional spark protection in the measuring channel to increase the fire safety of the system.

The discrete proportioning of surfactant solutions, water glass, caustic alkalis, and various plasticizing agents used in the technology of granulated batch preparation is most frequently performed using strain-gage weighing proportioners consisting of a frame, a cylindrical tank, a strain-gage weight suspension, ball valves, and corresponding pneumatic charge and discharge drives. The dosing limit for particular liquids or solutions varies in the range of 1.5 to 300 kg depending on the tank capacity and the design of the discrete proportioner, and the average dosing error does not exceed ± 0.1%.

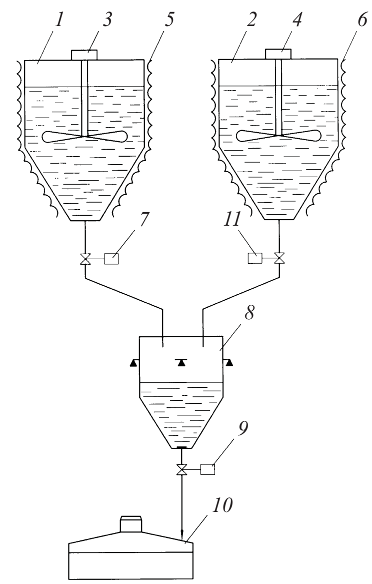

Fig. 2. System for dosing potash solution.

The most difficult is to proportion viscous fluids and aqueous solutions of saltpeter and potash.

The potash-dosing system (Fig. 2) developed by the Stromizmeritel' JSC initially prepares a water-potash mixture in two supply tanks *1*, *2* equipped with mixers *3*, *4*, which mixture, to prevent precipitation and crystallization of potash, is constantly agitated and heated with electric heaters *5*, *6*. After mixing, a portion of the solution from tank *1* using charge valve *7* with an executive mechanism is fed to strain-gage weigher *8* and weighed. Next, discharge valves *9* opens and the mixture is poured by gravity into batch mixer *10*. After the solution in tank *1* ends, the water-potash mixture is fed to the weigher through charge valve *11* from supply tank *2*, and meanwhile, if needed, new solution is prepared in tank *1*, etc. After the end of the operation of this system, the supply tanks, the weighing hopper, and the pipelines supplying solution to the weigher and mixer should be washed with water.

The proportioning of saltpeter is performed in a similar way.

Thus, the use of various liquid and solution proportioners produced by the Stromizmeritel' JSC makes it possible to mechanize and automate the processes of moistening and plasticizing of glass batches and multicomponent mixtures in the production of ceramics and building materials.